E-2 AIRBORNE EARLY WARNING (AEW) HAWKEYE 2000

Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	75	Northrop-Grumman – Platform Integrator
Total Program Cost (TY$):	$2.4B	Johns Hopkins – CEC and ACIS Software
Average Unit Cost (TY$):	$320M	Raytheon Systems – CEC Hardware
Full-rate production:	2QFY01 (MCU)	Lockheed-Oswego – ESM
	2QFY04 (CEC)	Raytheon and Compaq – MCU
MCU OPEVAL:	1QFY01 –2QFY01	Allied Signal – 15 ton Vapor Cycle

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Hawkeye 2000 is an umbrella term for multiple improvements to the Group II E-2C. Multiple contractors working as a team, each responsible for separate improvements, compound the challenges of conducting OT&E. These improvements include the addition of: (1) an upgraded inertial navigation system, (2) an environmentally friendly and higher output 15-ton Vapor Cycle system, and (3) Ultra-High Frequency (UHF) Satellite Communications (SATCOM). They also include the replacement of the: (4) current mission computer with commercial-off-the-shelf computer (Mission Computer Upgrade [MCU]); (5) three control and display consoles with commercial-off-the-shelf workstations (Advanced Control Indicator System [ACIS]); and (6) current AN/ALR-73 Passive Detection System with an Electronic Support Measures (ESM) system; as well as (7) integration of the airborne variant of the Cooperative Engagement Capability (CEC) system; and (8) development of a Mission Information Transfer System

(MIST). Additionally, the program office is replacing the current four-blade propellers with eight-blade propellers.

The deployable, carrier and land-based capable Hawkeye 2000 E-2C, with its family of onboard sensors, multiple voice and data links, and decision maker support systems provide *mobile*, *agile*, and *dispersed* **Command and Control**. The effective integration of Link 11/TADIL A, Link 16/TADIL J, and CEC into the Hawkeye 2000 provide **interoperability** required for **Joint and Multinational operations**.

BACKGROUND INFORMATION

Hawkeye 2000 is the most recent of a series of modifications aimed at improving the capability and sustainability of the E-2C, making it a powerful C2 tool in support of ***information superiority, precision engagement,*** *and* ***dominant maneuver***.

E-2C improvement modifications will occur incrementally, not in a block upgrade. The modifications will be incorporated into new E-2C aircraft production (approximately four annually) and will be retrofitted into older E-2C aircraft, if funding becomes available.

The key objective of the CEC modification is to provide the Navy with an airborne sensor and relay to extend the surface-based coverage. The airframe was modified to carry the CEC antenna under the center fuselage (see photo), the liquid cooling system for the AN/APS-145 surveillance radar was modified to support CEC coolant needs, and the current vapor cycle system was replaced with a higher output system to support the increased environmental control requirements of the new modifications.

In order to accommodate CEC hardware, the E-2C required increased mission computing and display capabilities, as well as an offset in weight and volume to carry the estimated 600-700 pound CEC equipment. The replacement of the analog computer with the MCU and the display stations with the ACIS provided the majority of the needed weight savings, computing, and display capabilities.

The UHF SATCOM modification relocates the current UHF SATCOM, which is currently voice-only, and adds the connectivity required to receive data and products but does not include the processing required to support display of data products on the ACIS. The ESM system, a derivative of the AN/ALQ-210 being developed for other platforms, replaces the current Passive Detection System, which is no longer available. The new ESM is only required to provide the same functionality as the system it is replacing. It is expected that the new ESM system will need less operator intervention, provide improved identification and display of data as well as increased reliability.

Both MCU and ACIS are also expected to support mission improvement capabilities beyond Hawkeye 2000.

TEST & EVALUATION ACTIVITY

The Annex A, E-2C CEC Modification to the CEC TEMP was approved in October 1999. The Hawkeye 2000 MCU TEMP was approved in July 2000.

The MCU modification, which completed software Formal Qualification Test in May 2000, entered Technical Evaluation (TECHEVAL) in July 2000, which will be followed by Operational Evaluation (OPEVAL) in October 2000. Commander, Operational Test and Evaluation Force presented a Test Concept briefing in 1999 and updated it in July 2000. The Test Plan is expected to be submitted for DOT&E approval during August 2000.

The CEC modification completed Developmental Test (DT) Phase I of flight testing in February, with 110 separate Hawkeye 2000 CEC flights (mostly in support of surface CEC testing); the program office used those flights to get information on the performance of the entire airborne system. These flights were flown by the only CEC-modified test E-2C aircraft and included CEC capable Land-Based Test Sites (LBTS), Lear Jet air targets, and leveraged surface ship CEC test events. A DT flight Phase I test message was released by the Naval Air Warfare Center.

Commander, Operational Test and Evaluation Force (COTF) completed OT-IIA-2, an OA of E-2C CEC in October 1999. DOT&E approved the OT-IIA-2 Test Plan in September 1999 and COTF provided a test report in March 2000. During the E-2C CEC OT-IIA-2, the CEC modified E-2C flew five missions for a total of 23.6 hours in the Virginia Capes area. The E-2C exchanged CEC information with two LBTS for all five missions and with two AEGIS Guided Missile Cruisers (CG) on the last mission day. The E-2C flew patrol orbits designed to provide airborne relay and extend Battle Group air surveillance coverage. Contract Lear Jets flew adversary aircraft and anti-ship missile profiles while the E-2C, on one mission, controlled F-15 aircraft as defensive Combat Air Patrol.

An operational E-2C squadron, VAW-117, has been designated as the MCU/ACIS modification OPEVAL squadron, and has received four E-2C aircraft modified with Low Rate Initial Production MCU and ACIS sub-systems. The squadron is employing the aircraft in normal operational training, exercise, and aircraft carrier deployment work-up flights.

During January and February 2000, three of VAW-117's MCU/ACIS equipped E-2C aircraft participated in the All Service Combat Identification Evaluation Team (ASCIET) 2000 event. The E-2C operated from Hunter Army Airfield in Savannah, GA, and flew 20 airborne early warning and fighter control missions overland and overwater. The E-2C provided air intercept control to USAF F-16, USN F-14D and F/A-18, and Royal Air Force Tornado F1 fighter aircraft. It also exchanged tactical information with a number of platforms including the E-3 Airborne Warning and Control System (AWACS), the Marine Tactical Air Operations Center, the Army Patriot Information and Coordination Central, a Navy AEGIS Guided Missile Destroyer, and a Royal Navy Frigate. While impressions about the overall performance were positive, the formal results (after-action report and briefing) were not available at the time this report was published.

TEST & EVALUATION ASSESSMENT

The Phase I E-2C CEC DT flight effort generated 202 deficiency reports—52 were Part I (Critical). Iterations of CEC, vapor cycle, MCU, and ACIS hardware, software, and firmware steadily reduced the number of open deficiencies by the end of the Phase I flight test to six Part I. These six include CEC data relay and five air tracking related deficiencies.

The E-2C CEC OA demonstrated that the E-2C was able to enter CEC networks, and provide and relay sensor data with other CEC capable LBTS platforms and AEGIS surface combatants. The ACIS workstations were very reliable (100 percent) during the OA. The development and integration is still

immature, and improvements in Battle Group interoperability air track manipulation, CEC subsystem reliability, MCU, and vapor cycle stability are still needed before OPEVAL. The COTF evaluation was "potentially" operationally effective and suitable."

While not a test, the participation of VAW-117 MCU-equipped E-2C aircraft at ASCIET 2000 provided valuable opportunity to assess the maturity of the MCU and ACIS in an operational environment. The E-2C's Link 16 interoperability to exchange air surveillance information demonstrated and indicates reduced risk for this feature for operational test.

LESSONS LEARNED

Modifications to existing systems, even when replacing an earlier but like functionality (especially with simultaneous multiple improvements) with an upgraded version, must be evaluated in an operationally realistic manner against valid or revalidated requirements. Testing must be supported by updated, coordinated, and approved TEMPs. If not, unintended impacts to other onboard systems may go unrecognized until deployment. Additionally, the fleet user, the Battle Group Commander, and Theater CINC will not be alerted to enhancements and limitations to their command and control capabilities imposed by these modifications.

Participation in exercises, such as ASCIET, even while in Developmental Test, provides valuable insight into risks and opportunities for operational test. Developers should be encouraged to participate where possible, and OTAs should monitor these exercises to collect data and encourage innovation and experimentation. This effort will help the developer learn what needs to be corrected.

Robust and credible DT flight testing can reduce OT effort and resources needed, refine needed training, increase confidence in results, and indicate areas of risk for both the developer and OTA. This was confirmed when the findings from the E-2C CEC OA were consistent with the results experienced in Phase I DT testing.